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The “Grid”:

Influence of Existing Infrastructure on Energy Development and Siting

Workshop on Onshore Implications

March 25, 2010

Grid Influence on Offshore Energy Siting

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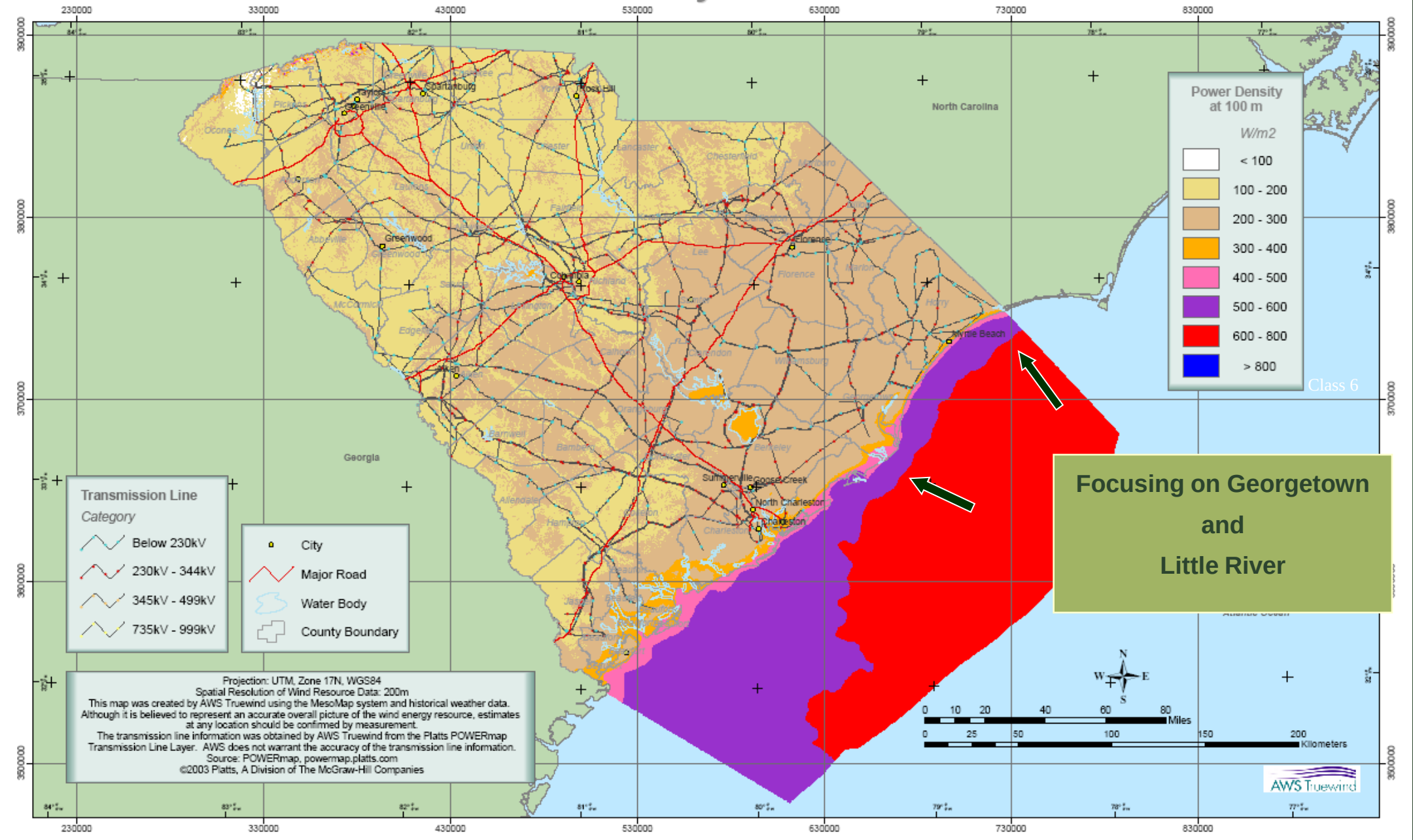
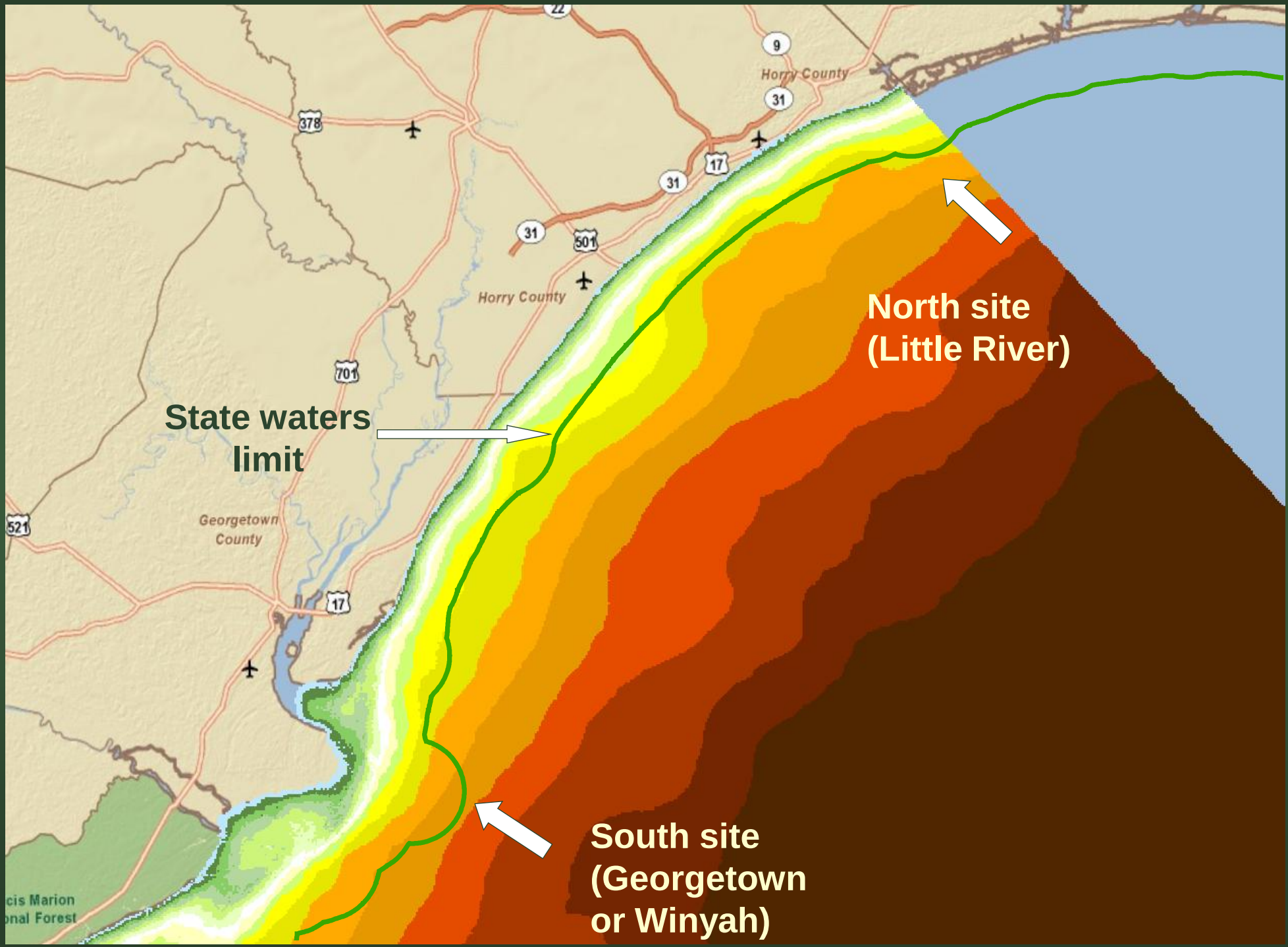
Two aspects to grid influence on siting

- Transmission lines back to shore
- Effect of the power on the system
  - Amount of power ► grid robustness
  - Intermittency - not limited to dealing locally with this

Mean Annual Wind Power Density of South Carolina at 100 Meters




Horry County
Horry County
Georgetown County
State waters limit
North site (Little River)
South site (Georgetown or Winyah)

SC Roadmap to Coastal Clean Energy

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3-part Mission:

- **Study Transmission Infrastructure and Develop Options for Integrating Offshore Wind**
- Study Wind, Wave and Current Energy for Wind Turbine Foundation Design and for Other Potential Marine Energy Development
- Regulatory Coordination Task Force to Develop Permitting Process

Partners:

SC Energy Office **Coastal Carolina Univ**
Clemson Univ Restoration Inst
Santee Cooper **NC State Univ**

PALMETTO RESEARCH PROJECT WIND

Transmission Study - Scope

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Three Future Scenarios

- Phase I - 80 MW in state waters by 2014
- Phase II - additional 1 GW in federal waters by 2020 (total 1,080 MW)
- Phase III - additional 2 GW in federal waters by 2030 (total 3,080 MW)

DOE says 1-5 GW of offshore wind generation for SC

Transmission Study - Assumptions

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- Power enters at North and South points
- Six logical locations to access 115kV network
- Used GE 3.6MW wind turbine parameters
- 34.5 kV stepped up to 115kV at interconnect locations
- Looked for
  - Acceptable voltage range for this purpose is 94%< V<106%
  - Line and transformer loading must be <100%
- Wind energy is distributed to four electric utilities in SC (Duke, Progress, SCE&G and Santee Cooper) based on load ratio share
- Existing generation at the four utilities are reduced according to the same load ratio share

Transmission Study - Results

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- The existing 115 kV network is sufficient for 80MW in 2014.
- The existing 115 kV network is sufficient for 1,080MW in 2020 under normal operating conditions.
- The existing 230kV network is also sufficient for 1,080 MW under normal operating conditions. This would in turn lower the flows on the 115kV network.

Transmission Study - Results

- The existing 230kV network is sufficient for up to 2.0 GW in the 2020 scenario under normal operating conditions.
- The 230kV network will require some new lines to handle the 3.08 GW scenario.

All results are stated with no contingency (n-1).

Transmission Study – Future Study

- Scenario III – 3080 MW and recommendations for redesign or upgrade
- Additional Studies on
  - Contingency and short circuit analysis
  - Dynamic stability
  - Voltage stability
  - Transient stability

Acknowledgments

- Dr. Adly Girgis and Dr. Elham Makram at Clemson Univ Electric Power Research (CUEPRA) and their student researchers
- Clemson's South Carolina Institute for Energy Studies
- Santee Cooper's Transmission Department
  - Tom Abrams
- SCE&G's Transmission Department
  - Clay Young
- South Carolina Regional Transmission Planning

Transmission Routing to Shore-based Interconnection

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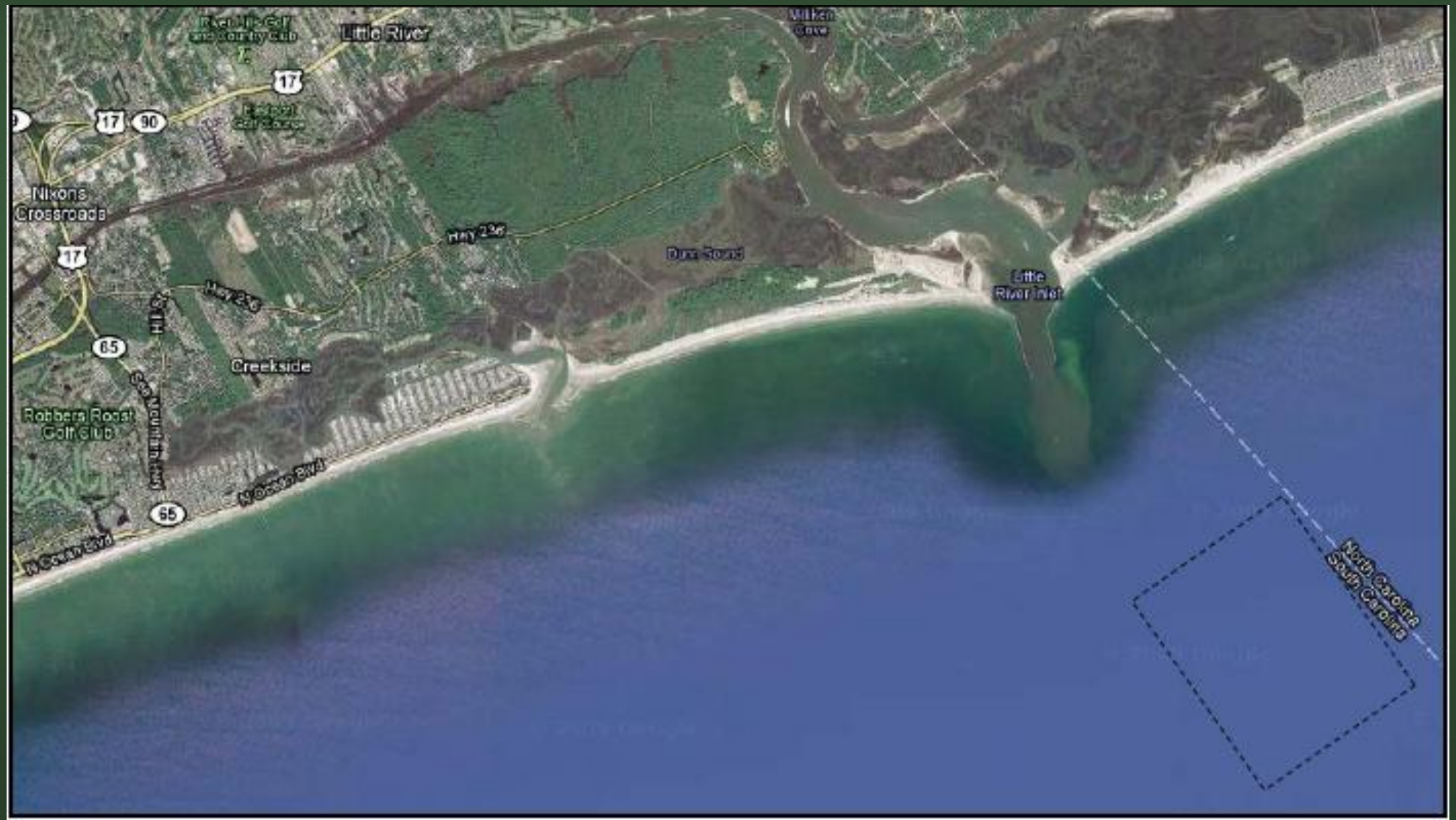

Transmission Routing to Shore-based Interconnection

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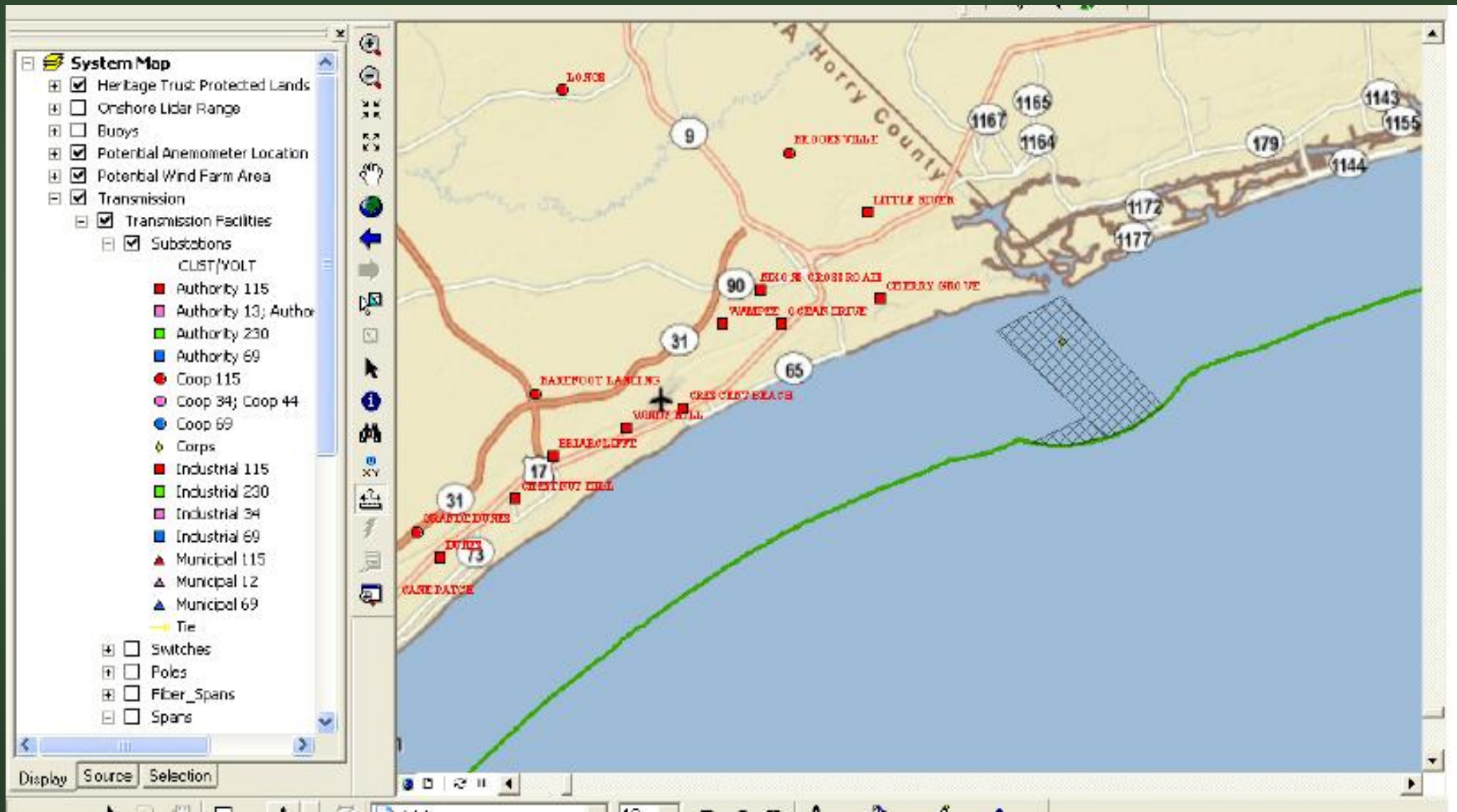

Transmission Routing to Shore-based Interconnection

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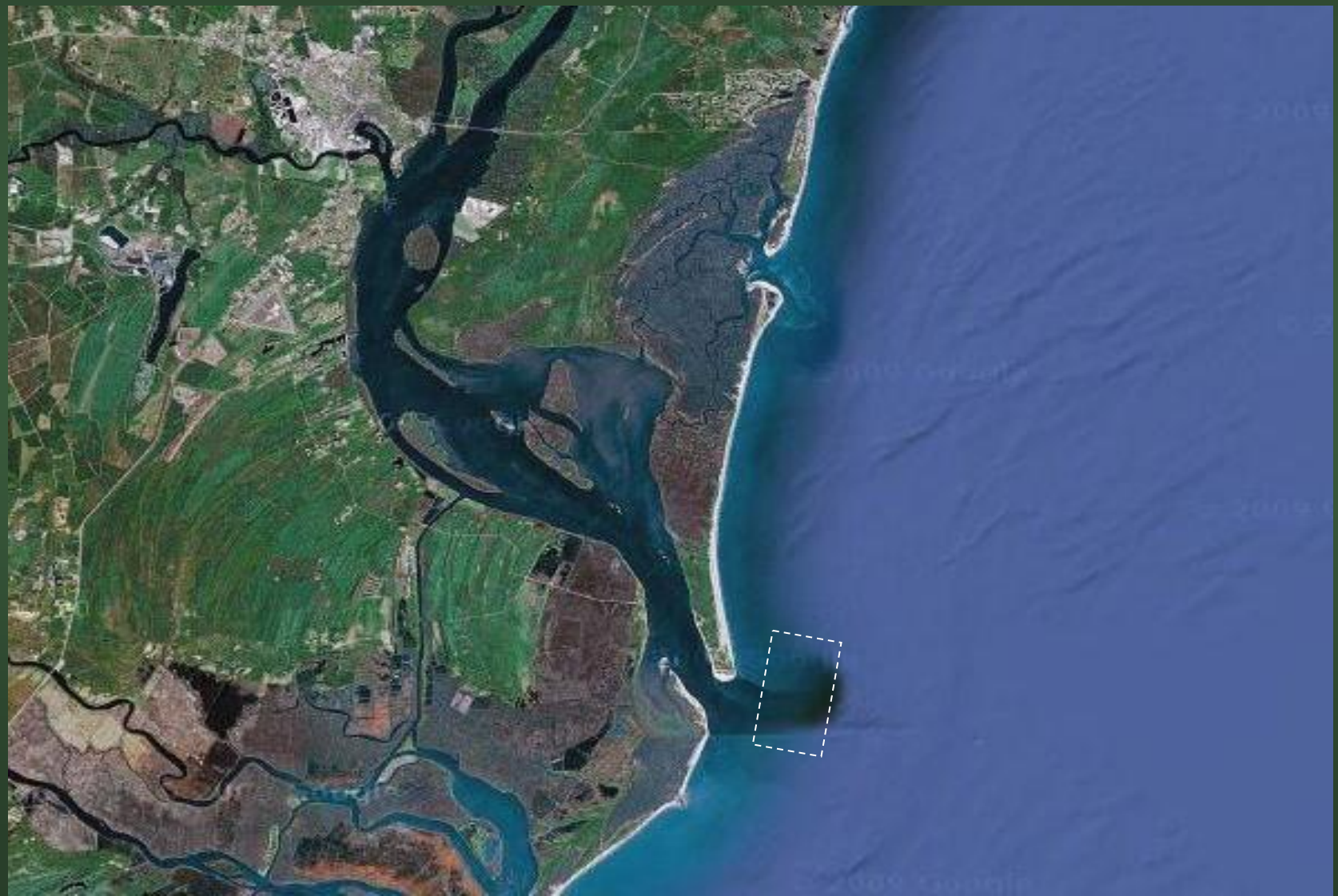

Transmission Routing to Shore-based Interconnection

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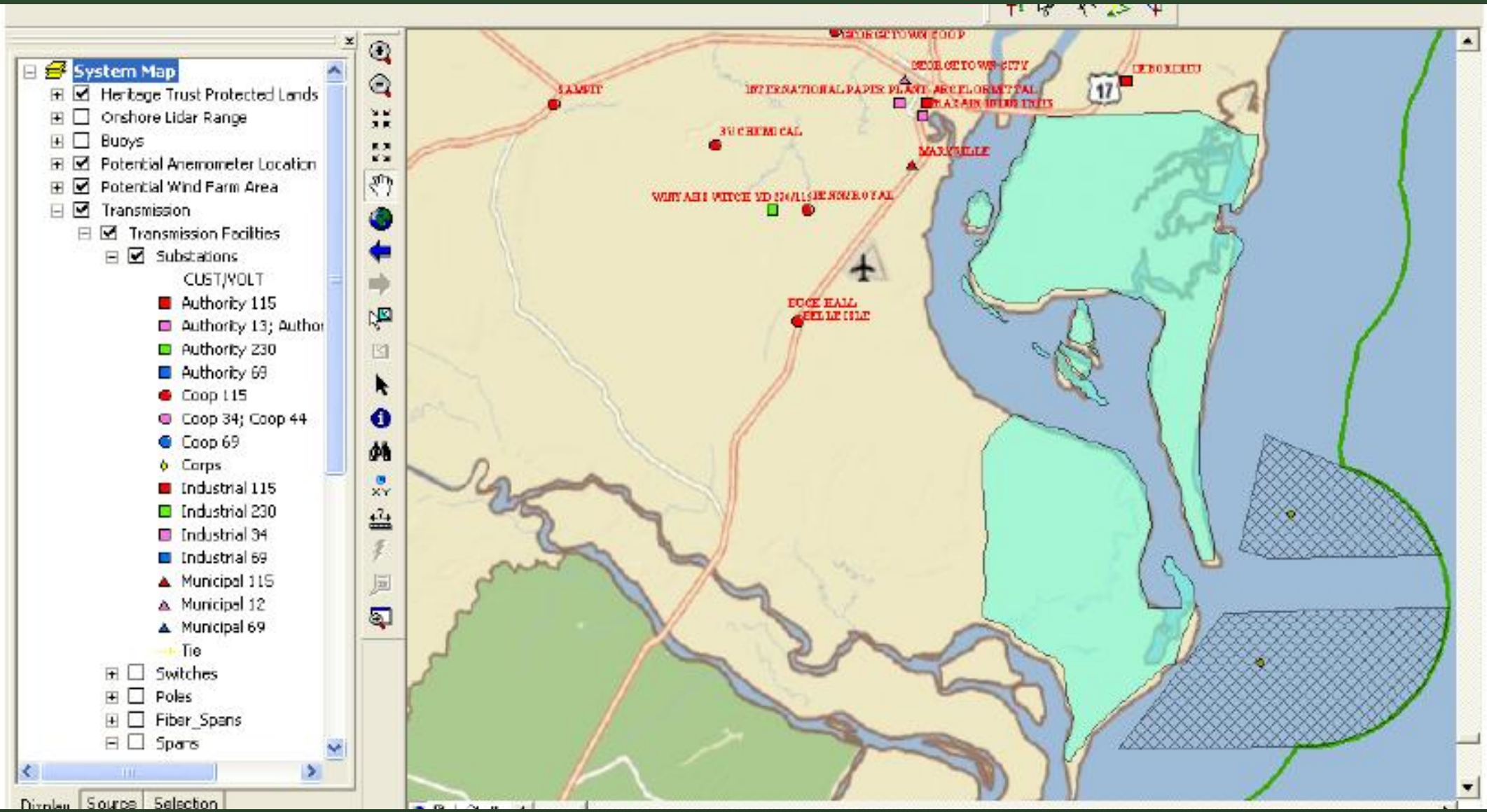

Conclusions

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- No project planned
- Lots of studies to be done
- Four entities in South Carolina have applied for MMS studies related to offshore wind investigations
  - RPI team – Marine Spatial Planning Database – Topic 8
  - CCU and Rutgers – Physical Oceanography - Topic 3
  - OCC/AWS Truewind – Visual Evaluations – Topic 6
  - CCU – Environmental Monitoring Technologies -Topic 4
- Continue our work along with other researchers in SC